

First Year Results of a Whitebark Pine Seed Planting Trial Near Baker City, Or.

Schwandt, John W.¹; Tomback, Diana F.²; Keane, Robert E.³; McCaughey, Ward W.⁴; and Kearns, Holly S.J.⁵

¹ Forest Pathologist, USDA Forest Service, Forest Health Protection, Coeur d'Alene, ID 83815

² Professor, Department of Biology, University of Colorado at Denver and Health Sciences Center, P.O. Box 173364, Denver, CO 80217

³ Research Ecologist, USDA Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory, 5775 Hwy 10 West, Missoula, MT 59808-9361

⁴ Research Forester, USDA Forest Service, Rocky Mountain Research Station, Forestry Sciences Laboratory, 800 E. Beckwith, Missoula, MT 59801

⁵ Forest Pathologist, USDA Forest Service, Forest Health Protection, Coeur d'Alene, ID 83815

Abstract

Whitebark pine occurs primarily in roadless areas, national forests, wilderness areas, or national parks and is declining throughout most of its range. Planting seedlings to restore whitebark pine in remote areas may be difficult logistically and not compatible with wilderness use, so a trial planting of 700 whitebark pine seeds was established in a whitebark pine site on Vinegar Hill near Baker City, Oregon. The trial included three treatments to enhance germination (warm stratification, seed scarification, and a combination of both), and three treatments to reduce rodent predation (Thiram, cayenne pepper, and caging). The results after nine months indicate warm stratification can significantly enhance germination, but treatment differences for rodent repellants were not yet observed.

Introduction

Whitebark pine is a keystone species of high elevation ecosystems throughout western North America (Tomback et al. 2000). Much of this range occurs in remote or relatively inaccessible areas where routine restoration by planting seedlings may not be possible (Keane 2000). Recent studies have found whitebark pine is in peril in much of its range (Kendall and Keane 2000, Schwandt, 2006), so alternatives such as direct planting of seeds need to be investigated. Whitebark pine seeds normally take at least two years to germinate (McCaughey and Tomback 2001, Tomback et al. 2001), but previous tests have indicated it may be possible to shorten the germination period by using a warm stratification period followed by cold stratification or by scarifying the seed coat (Burr et al. 2001). Rodent predation of planted seed may also be a major factor in restoration success (McCaughey pers. com) and needs further investigation.

Therefore a pilot study was designed to determine 1) if seed could be planted effectively and 2) if different seed treatments could be used to enhance germination and reduce rodent predation. This study was implemented on whitebark pine sites with good access, local seed already in storage, and strong interest by local resource professionals.

Methods and Materials

On November 1, 2005 a trial project using a total of 700 whitebark pine seeds from a local seed source was installed in a whitebark pine site at Vinegar Hill, about 35 miles west of Baker City, Oregon. This area of the Malheur National Forest is a prime whitebark pine site, about 7600 ft. in elevation along a southwest facing ridge with scattered clumps of whitebark pine mixed with lodgepole pine and subalpine fir (fig. 1).

The subalpine fir and lodgepole pine had been cut or girdled to enhance growth of existing whitebark pine and encourage natural regeneration. The slash piles had been burned the previous year and the small burned areas were selected to install five experimental blocks or treatment replicates containing seven 20-seed treatments per replicate. The seven treatments included three treatments to enhance germination and three treatments to reduce rodent predation plus a control. Treatments were randomly assigned locations within each of the replicates.



Fig.1. Small burned area and surrounding vegetation on Vinegar Hill prior to installation of seed planting trial.

To test for warm stratification effects, 200 seeds were washed and stored 21 days at 50 °F prior to planting. One hundred of these seeds were individually hand-scarified with sandpaper after the warm stratification. Another one hundred seeds were scarified only, and an additional 100 seeds were used as controls and planted without any scarification or warm stratification. All the treatments to enhance germination were covered with hardware cloth cages to prevent rodent predation since prior tests of direct seeding suffered severe rodent predation (McCaughey 1990).

Cages were made from a standard roll of 19 gauge $\frac{1}{2}$ " mesh 24" wide hardware cloth cut into 7 foot lengths with a 6 inch top and 9 inch sides. The lower 3 inches of each side were bent out to create a lip to prevent rodents from burrowing down the side and under the cage (fig



Figure 2. Hardware cloth cages to prevent rodent predation and logs to provide shade

2). Cages were buried 2-3 inches deep and anchored with six inch nail spikes. Treatments using the remaining 300 seeds were not covered with hardware cloth to test efficacy of two rodent repellants, Thiram® and cayenne pepper dust, against an untreated control. Thiram® (tetramethylthiuram disulfide) is used as a seed protectant for fungal diseases and as an animal repellant to protect fruit trees and ornamentals from damage by rabbits, rodents, and deer (Meister, R.T. 1992). Seeds were soaked for 2 minutes in a solution of Thiram diluted 1:1 with tap water, allowed to dry 3 hours, and then soaked a second time and dried 8 hours at room temperature.

Rodent repellants using hot pepper are also commonly recommended for rodent control (Smith, pers. com.).



Fig. 3. Cayenne pepper treatment

Cayenne pepper powder was shaken into a bag with 100 seed and also liberally shaken into and around the planting hole after planting each seed in this treatment (fig 3.)

Seeds in each treatment were sown in a single row, six inches apart, and one inch deep using a flat rubber template with pre-drilled holes (fig. 4). All but 3-4 inches of twelve inch metal stakes were permanently buried three inches from the last seed at both ends of each row to facilitate measurements in the future. Rows were spaced at two foot intervals and logs 8-12 inches in diameter and seven feet long were placed 3 inches from each row of seeds to provide shade. Logs were oriented on a bearing of 300 degrees to allow early morning sun on the treatments but provide maximum shade in the afternoon. Hobo® weather instruments were installed to monitor relative humidity, precipitation, and ambient temperature every hour.

The site was re-visited July 19, 2006 (nine months after planting) check for germination in the various treatments. Seed locations were found using a tape marked at six inch increments and stretching between the two metal stakes used mark both ends of each row (fig 5). Germination at each seed planting location was noted along with notes regarding seedling condition (live, fading, top kill, or dead) and brush encroachment. Results were tested using the Pearson Chi-square test for statistical significance



Figure 4. Planting Thiram coated seed through rubber template with holes at 6 inch intervals



Fig. 5. Whitebark pine seedling 9 months after planting

Results and Discussion

A total of 94 of the 700 seeds germinated between November 1, 2005 and July 19, 2006.

to
it
to

Germination of the warm stratification treatment seeds was 38%, and warm stratification plus scarification treatment seeds had 25% germination. These treatment differences were highly significant ($P < .001$) from all other treatments (fig. 6).

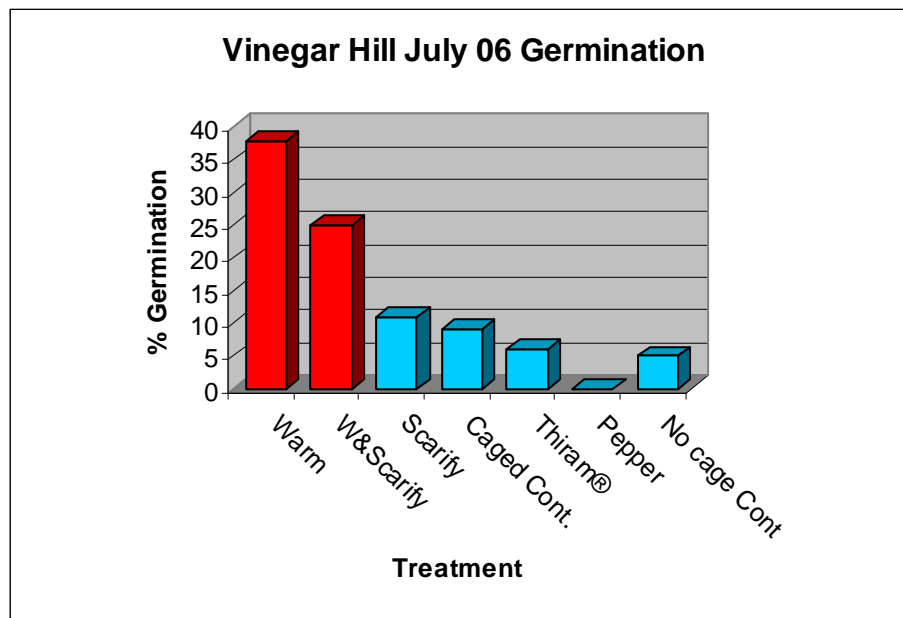


Fig. 6. Percent whitebark pine seed germination after 9 months, by treatment

Germination in the five replicates varied from a total of 7 (5%) to 27 (19.3%) seeds out of 140 seeds per replicate (Table 1.) The warm stratification treatment had significantly greater germination in three of the five replicates while the warm stratification combined with seed scarification had significantly greater germination in one other replicate. Germination was very low for all treatments in the first replicate.

Table 1. Whitebark pine germination in each treatment and replication – July, 2006; significant (*) and highly significant (**) treatment differences.

TREATMENTS\ REPS:	1	2	3	4	5	totals
Warm Stratification (caged)	2	9*	2	12*	13*	38**
Warm Strat. & Scarify (caged)	0	6	12*	1	6	25**
Scarify only (caged)	1	5	2	0	3	11
Caged Control	0	3	5	0	1	9
Pepper (no cage)	0	0	0	0	0	0
Thiram® (no cage)	1	3	2	0	0	6
No cage Control	3	1	1	0	0	5
Total Seeds Germinated	7	27	24	13	23	94
Percent Germination	5.0	19.3	17.1	9.3	16.4	13.4

Since germination normally takes at least two years (McCaughey 1993, Tomback et al. 2001), not much germination was expected in the rodent repellent treatments or controls. None of the 100 seed that were treated with cayenne pepper germinated and only 6 % of the Thiram treated seed germinated. These were not significantly different from the 9% germination in the caged control and the 5% germination in the uncaged control. Four percent of the 94 germinants were dead and a few others were wilted or chlorotic.

Some plots had abundant shrub growth (figs. 7a & b) which may provide additional shading for seedlings. However, it also made it difficult to locate seedlings and could create problems for seedling growth in the future. The wire mesh cages sustained minor animal or snow damage during the winter so additional braces or stiffer gauge wire may be desirable in future installations.

Further monitoring is planned for the fall of 2006 to see how the germinants survived the driest summer in many years plus annual summer and fall inspections are planned the next several years to check for additional germination and to monitor seedling survival over time. A similar test was initiated in the fall of 2006 southwest of Bend, Oregon on Mt. Batchelor and other tests are planned throughout the range of whitebark pine to get a better understanding of the potential of this technique for restoration.



Fig. 7 (A & B). Extensive shrub growth on some plots

Acknowledgements:

This study was a team effort and our sincere thanks to the dedicated group of resource professionals that scouted the area and installed the trial in a driving snow storm. This included: Vicki Erickson, Karen Prudhomme, Vince Novotny, Steve Duncan, Paul Phelps, Victoria Rockwell, Holly Kearns, and Jim Hoffman. We also greatly appreciated advice and assistance from Jerry Berdeen (Dorena Genetic Resource Center) as well as his efforts to stratify and treat the seed in time for planting.

Literature cited:

- Burr, K.E.; Eramian, A.; Eggleston, K. 2001. Growing whitebark pine seedlings for restoration. *In*: Tomback, D.F.; Arno, S.F.; Keane, R.E. (Eds.), Whitebark Pine Communities: Ecology and Restoration. Island Press, Washington, D.C., U.S.A., pp. 323-345.
- Keane, Robert, E. 2000. The importance of wilderness to whitebark pine research and management. *In*: Proceedings of the symposium: Wilderness Science: In a time for change. Volume 3: Wilderness as a Place for Scientific Inquiry. USDA Forest Service General Technical Report RMRS-P-15-VOL-3. Pages 84-93
- Kendall, K. and R.E. Keane. 2001. Whitebark pine decline: infection, mortality, and population trends. Pages 221-247 *In*: D. Tomback, S.F. Arno, and R.E. Keane (Editors): Whitebark pine communities: Ecology and Restoration. Island Press, Washington DC, USA. 440 pages
- McCaughey, Ward. W. 1990. Biotic and microsite factors affecting *Pinus albicaulis* establishment and survival. Doctoral dissertation, Montana State University, Bozeman, Montana.
- McCaughey, Ward. W. 1993. Delayed germination and seedling emergence in *Pinus albicaulis* in a high elevation clearcut in Montana, USA. *In* D.G. Edwards (compiler) symposium Proceedings: Seed dormancy and barriers to germination. Forestry Canada, IUFRO project group P2.04-00, Victoria, BC, Canada. Pp.67-72.
- McCaughey, Ward. W. Personal communication. Research Forester. USDA Forest Service, Rocky Mountain Research Station, Forestry Sciences Lab, Montana State University, Missoula, Mt.
- McCaughey, W.W.; Tomback, D.F. 2001. The natural regeneration process. *In*: Tomback, D.F.; Arno, S.F.; Keane, R.E. (Eds.), Whitebark Pine Communities: Ecology and Restoration. Island Press, Washington, D.C., U.S.A., pp. 323-345.
- Meister, R.T. (ed) 1992. Farm Chemicals Handbook. Meister publishing co. Willoughby, Ohio.
- Schwandt, J.W. 2006. Whitebark Pine in Peril: A case for restoration. USDA Forest Service, Report R1-06-28, Missoula, Montana.
- Smith, R. 2006. Personal communication. Horticulturist, North Dakota State University Extension Service.
- Tomback, D.F.; Anderies, A.J.; Carsey, K.S.; Powell, M.L.; Mellmann-Brown, S. 2001. Delayed seed germination in whitebark pine and regeneration patterns following the Yellowstone fires. *Ecology*: 82 (9):2587-2600.